# Nerves of the Upper Extremity

## Introduction

This lesson is about the nerves of the upper extremity. Immediately, students conjure horrors of the dreaded "brachial plexus." We remember anatomy class back in the day, drawing the brachial plexus over and over again. We've seen resources for board review that give memory cues and mnemonics for drawing it correctly.

DO NOT EVER DRAW THE BRACHIAL PLEXUS.

Learning the nerves of the upper extremity does involve understanding the brachial plexus because there are some injuries that damage the brachial plexus. But most of the understanding of the nerves of the upper extremity comes from the terminal nerves, the output of the brachial plexus. We touch on the brachial plexus itself, sharing with you the understanding necessary for the rest of the lesson (and driving home the limited clinical utility of mastering the brachial plexus). We then delve into the cutaneous sensory innervation of the upper extremity (the cervical dermatomes and the terminal nerve sensory maps), look at neurovascular pairings, review motor innervation of the upper extremity learned previously, and close with pathology: one section on the brachial plexus lesions, one on the lesions of terminal nerve branches.

## Brachial Plexus Anatomy

Nervous tissue (the axons of sensory and motor neurons), at the point of exiting the vertebral column, is called a **nerve root**. Nerve roots coalesce at the brachial plexus to form trunks, trunks crisscross projections to form divisions, divisions become cords, and cords become **terminal nerves**. See which was bolded?

Nerve roots are damaged by radiculopathy and spinal trauma. Nerve roots will provide nervous tissue to multiple terminal nerves. The only way nerve roots are useful is in assessing **cutaneous lesions in dermatomes**, as described below. You should not attempt to trace a cervical nerve root to a given terminal nerve. One nerve root will provide nervous tissue to multiple terminal nerves. One terminal nerve will receive nervous tissue from multiple nerve roots. That crisscrossing of nervous tissue is what the brachial plexus does. Accept that it happens; don't try to figure out how (beyond what we're about to tell you).

The brachial plexus receives nerve roots from C5 to T1. C5 is the highest cervical vertebra of the plexus. The terminal nerves that the nerve root from C5 will contribute to are higher on the arm. "Higher" on the arm is lateral shoulder. T1 is the lowest cervical vertebra of the plexus. "Lower" is medial shoulder, the axilla. The "middle" is the tip of the middle finger. That means the contribution of nerve roots will run from C5 at the lateral shoulder, down to the tip of the finger at C7, and then back up to the axilla to T1. Here's the problem. The terminal nerves that do the forearm and hands, the radial nerve and median nerve, have contributions from C5 to T1. Yes. That's right. All of them.

So why is the brachial plexus a thing? Because a surgical anatomist attempting to trace the brachial plexus in a human cadaver had a really hard time figuring out where things came from and went. The good news is, there are very specific diseases, each with its own unique presentation and mechanism, so that you do not have to figure out the plexus. Any citing of the plexus is meant only for reference, never to be remembered.

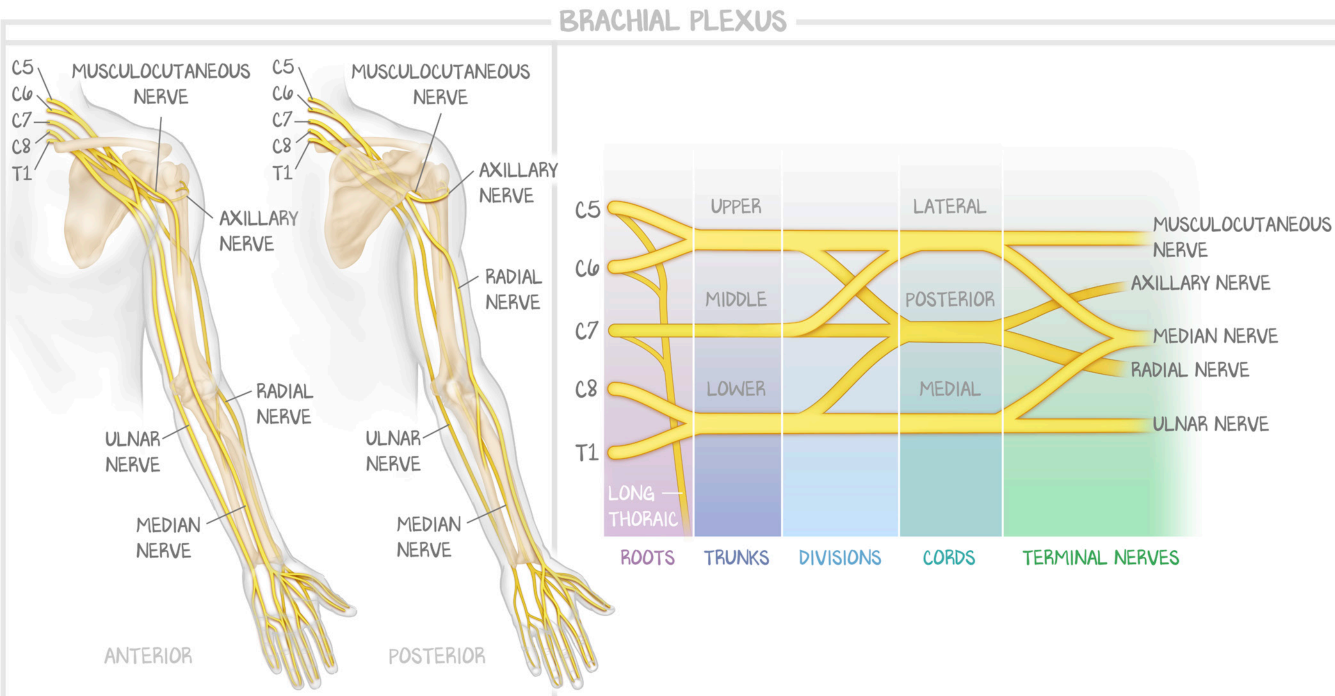



**Figure 3.1: Brachial Plexus**
Anterior and posterior views of the arm demonstrate which nerve roots contribute to the brachial plexus and which terminal nerves come out of the brachial plexus. While there are plenty more nerves that exit the brachial plexus, simplifying it down to "only five" makes mastering this subject easier, without compromising fidelity.

## Cutaneous Sensation 1: Introduction

The skin is innervated by sensory nerve fibers. "Sensory nerve fibers" is intentionally vague, because there are two ways of mapping sensation. One is by dermatome, a region of skin innervated by a nerve root, the sensory nerve fiber as it exits the vertebral column. The other is by the innervation of the skin by terminal nerves. Because nerve roots enter the brachial plexus, mix and match, and exit as terminal nerves, it means that any one terminal nerve is a combination of multiple nerve roots and that any nerve root can contribute to multiple terminal nerves. That means there are **two distinct maps** of sensation you have to learn. The good news is that a **dermatomal distribution is contiguous** within the dermatome and the **terminal nerve distribution is contiguous** within the terminal nerve distribution.

## Cutaneous Sensation 2: Dermatomes

**Dermatomes** on the torso make a lot of sense. The dermatomal distribution of T8 is a ring of skin starting at the exit of the nerve at T8, wrapping around the torso to the anterior. There is left and right nerve root, so the dermatome meets, but does not cross at midline. The extremities are challenging because, at first glance, there is no rhyme or reason to the way it works. But try this visualization exercise. Follow along with Figure 3.2. See the torso and head as a cylinder. On the back of that cylinder is the spine. Dermatomes stretch out from the spine and around the cylinder. Now imagine that, at C7, a hand, palm towards you, starts to push out of the cylinder. The cylinder is made of stretchy material. The hand pushes, dragging C7 along with it, C7 wrapped around the middle three fingers. Next the hand rises, pushing even more through the stretchy cylinder, which stretches dragging C8 on the bottom and C6 on the top, conforming to the hand. Then the forearm appears, and it drags the dermatome of T1 on the bottom, which conforms to the bottom of the forearm. As the upper arm appears, C5 gets stretched from the top, covering the arm, elbow, and some of the forearm. Finally, the shoulder appears, dragging T2 on the bottom (axilla) and C4 on the top (deltoid).

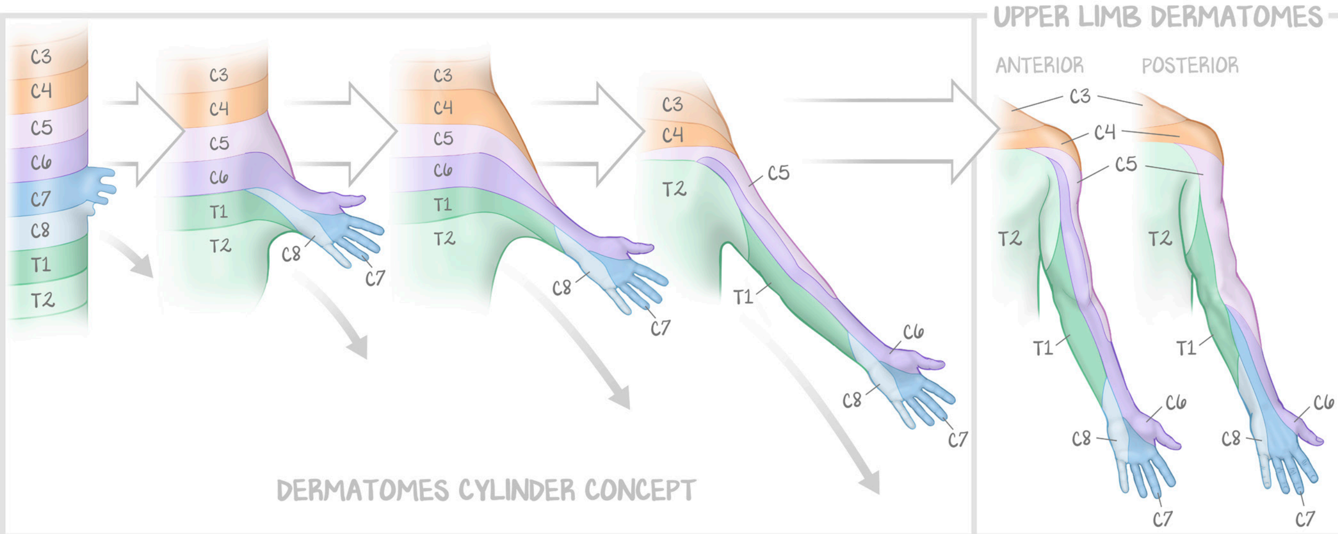



**Figure 3.2 Dermatomes**
A visualization of the previous paragraph and an accurate representation of the completed dermatome map of the upper extremity.

## Cutaneous Sensation 3: Terminal Nerves

Linking the **sensory innervation** of the arm and forearm to **specific nerves** is fairly easy to do if you can get the order down. Start at the "top," on the lateral shoulder, then work your way down. Follow along with Figure 3.3. The **supraclavicular** nerve and then **axillary** nerve take on the anterior and posterior aspect of the shoulder. From there, we want you thinking in terms of posterior and anterior.

The **posterior** is easy; it is all radial nerve. The **radial** nerve catches the lateral arm over the humerus, but should be considered the **posterior arm, posterior forearm,** and **posterior dorsum of the hand**. The radial nerve also serves as motor innervation to the triceps and posterior compartment of the forearm—all extensor muscles. The nerve distribution matches the motor distribution.

The **anterior** is bit more tricky, but not by much. The **musculocutaneous** nerve picks up the lateral forearm where the radial nerve left off at the lateral arm over the humerus. The **median** nerve innervates the lateral palm. The **ulnar** nerve innervates the **medial** palm. Now wait a minute, we're missing the medial forearm and arm. No worries, because the sensory innervation of those regions comes from the medial cord of the brachial plexus, exiting as terminal nerve branches named the medial cutaneous nerve of the forearm and the medial cutaneous nerve of the arm. They aren't bolded because they are named so well. And because they are named so well, you won't get asked a question about them, and they do not appear in any of the nerve injuries you have to know.

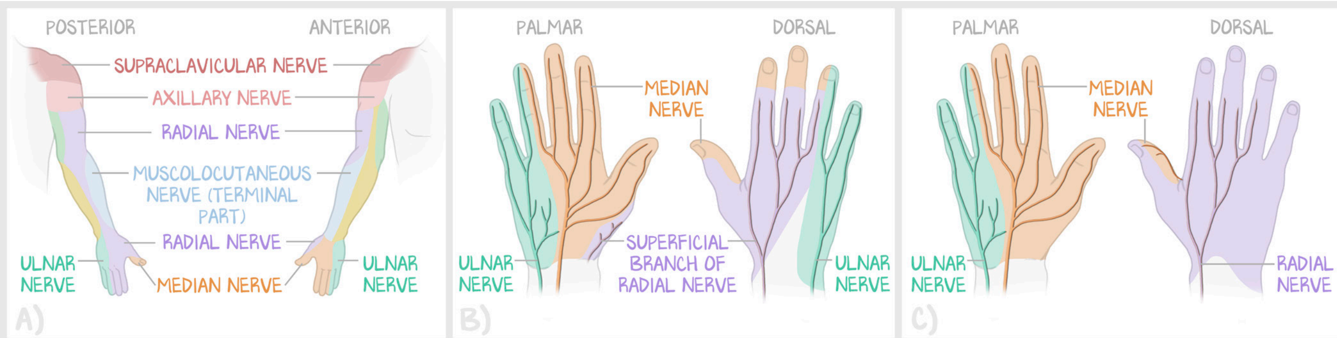



**Figure 3.3: Cutaneous Innervation of the Upper Extremity**
(a) A map of the terminal nerves' cutaneous distribution on the arm. (b) An accurate depiction of the innervation of the hand. (c) Hand nerves for Dummies.

The **hand** warrants a bit more attention. In general, the median nerve does the lateral palmar hand, the ulnar nerve does the medial palmar hand, and the radial nerve does the dorsal hand. But it is a bit trickier than that. Specifically, the **ulnar nerve** innervates the cutaneous sensation of **digit 5** and **half of digit 4,** on **both dorsal and palmar aspects**. The rest of the cutaneous innervation of the hand is divided between the **median nerve (palmar surface)** and the **radial nerve (dorsal surface)**, except digits 2 and 3, of which the median nerve innervates the dorsum of the distal digits.

The motor innervation is more simplistic, mirroring the "in general" arrangement. The ulnar nerve innervates the intrinsic flexors of digits 4 and 5 (the medial palm), the median nerve innervates the flexors of digits 1, 2, and 3 (the lateral palm), and the radial nerve innervates the extrinsic flexors of all the digits (dorsum of hand). Mastering cutaneous innervation may be excessively challenging in its detail. If that last paragraph confused you, just go with medial palm ulnar, lateral palm median, posterior palm radial for motor and cutaneous innervation.

## Neurovascular Pairing Mismatches

"Neurovascular pairing" is about knowing which nerve (neuro-) is irrigated by which artery (-vascular). Each neurovascular pairing is anatomically related, which means that fracture can result in injury of either or both the artery or the nerve. If an artery is injured, the nerve it irrigates will lose its blood supply, and may also be compromised.

Sometimes, the name of the artery matches the name of the nerve it innervates. Sometimes it doesn't. Here's the thing: the terminal branches of the brachial plexus arise at the level of the brachial plexus—way high up in the arm. Some of those nerves travel all the way down the arm and into the hand. At the level of the brachial plexus, the axillary artery is the common tributary of arteries. The radial and ulnar arteries aren't even formed until below the elbow. So let's trace each of the major nerves.

The **axillary nerve** is irrigated by the **humeral circumflex artery**, not the axillary artery. The axillary artery terminates in the shoulder, and does not need to be followed further.

The **radial nerve**, where it originates and travels down the posterior of the upper arm, is paired with and irrigated by the **deep brachial artery**. The radial nerve travels down the posterior forearm and dorsum of the hand. When the radial artery originates in the antecubital fossa, the radial artery innervates the radial nerve.

The **median nerve**, where it originates and travels along the anterior of the upper arm, travels with the **brachial artery**. When it gets past the antecubital fossa, there is no such thing as a median nerve. Instead, the median nerve, which travels between the radius and ulna (between the radial and ulnar nerves, between the radial and ulnar arteries, and between the radius bone and ulna bone), is fed by the interosseous artery.

The **ulnar nerve**, where it originates and travels along the medial upper arm, travels close to the brachial artery. It isn't as in line as the median nerve, and brachial branches called ulnar collaterals irrigate the ulnar. After the antecubital fossa, the ulnar nerve is irrigated by the ulnar artery.

| NERVE | ARTERY ARM | ARTERY FOREARM |
|---|---|---|
| **Axillary** | **Humeral circumflex** | N/A |
| Musculocutaneous | Brachial | N/A |
| **Radial** | **Deep brachial** | Radial |
| **Median** | **Brachial** | **Interosseous** |
| Ulnar | Brachial | Ulnar |

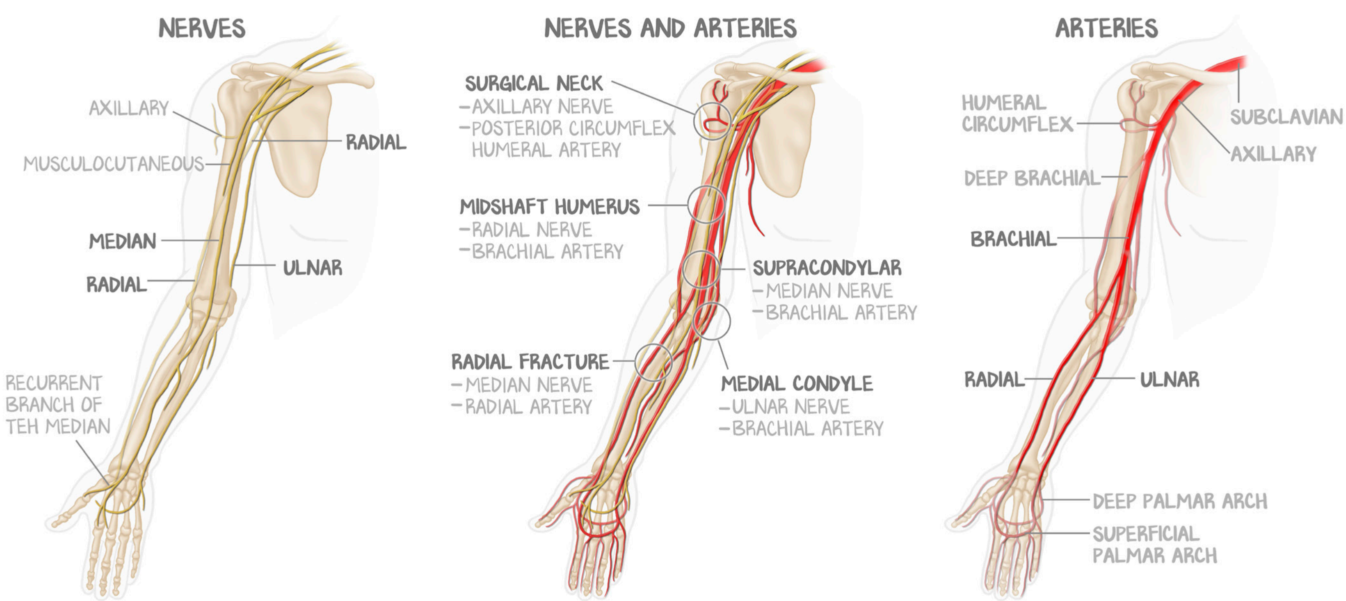



**Figure 3.4: Nerves and Arteries of the Upper Extremity**
Because the terminal nerves originate in the brachial plexus while the arteries continue to branch and bifurcate down the length of the arm, the neurovascular pairings rarely match names. But following them together enables one to predict which type of fracture could compromise which neurovascular pairing.

## Motor Innervation

This section is a series of tables, reminding you what you've already learned so far. We're going to need this information to discuss brachial plexus lesions. Since you have the tables above for the new stuff, we've given you these tables below for the old stuff, so you can flip back and forth as we move through the lesions.

| MUSCLE | MOTION | NERVE |
|---|---|---|
| Deltoid | Abduction 15°–100° | Axillary |
| Serratus anterior | Abduction > 100° | Long thoracic |
| Biceps | Supination of forearm<br>Flexion of elbow | Musculocutaneous |
| Triceps | Extension at elbow | Radial nerve |
| Latissimus dorsi | Adduction, extension, internal rotation of shoulder | Thoracodorsal |

**Table 3.1: Summary of Shoulder Muscle Innervation**
The innervation and function of the muscles.

| MUSCLE | MOTION | NERVE |
|---|---|---|
| Posterior forearm | Extension at wrist<br>Extension of fingers | Radial nerve |
| Anterior forearm | Flexion at wrist<br>Flexion of fingers, pronation | Median and ulnar nerves |

**Table 3.2: Summary of Forearm Muscle Innervation**
The innervation and function of the muscles.

| MUSCLE | MOTION | NERVE |
|---|---|---|
| Thenar muscles<br>(the ones with "pollicis") | Control the thumb | Median nerve |
| Hypothenar muscles<br>(the ones with "digiti minimi") | Control the pinky | Ulnar nerve |
| Lumbricals | Flex at MCP<br>Extend at DIP/PIP | 1$^{st}$ and 2$^{nd}$ = Median nerve<br>3$^{rd}$ and fourth = Ulnar nerve |
| Interossei | Abduction, dorsal (DIP)<br>Adduction, palmar (PAD) | Ulnar nerve |

**Table 3.3: Summary of Intrinsic Hand Muscle Innervation**
The innervation and function of the muscles.

## Brachial Plexus Lesions 1: Intro

There are two main categories of brachial plexus lesions—those that occur within the brachial plexus, and therefore affect multiple terminal nerves, and those that occur after the brachial plexus, and therefore affect one terminal nerve. The higher up a lesion occurs, the more sensory and motor deficits there will be. Terminal nerve injuries can be separated into those that occur in the arm (and affect everything, including arm and hand) and those that occur in the hand (affecting only the hand). The hand diseases we covered in the last lesson with carpal tunnel and Guyon's canal. For each of these lesions you must be able to identify the lesion by a description of what the patient can and cannot do, and by what a patient looks like, and then link it to a specific mechanism of injury.

The goal here is to memorize the lesions (thus the table at the end of this section), but also to work through the motor and sensory innervations to reinforce that memorization. DO NOT DRAW THE BRACHIAL PLEXUS. This illustration is for you to trace the lesions to prove to yourself which nerves are affected.

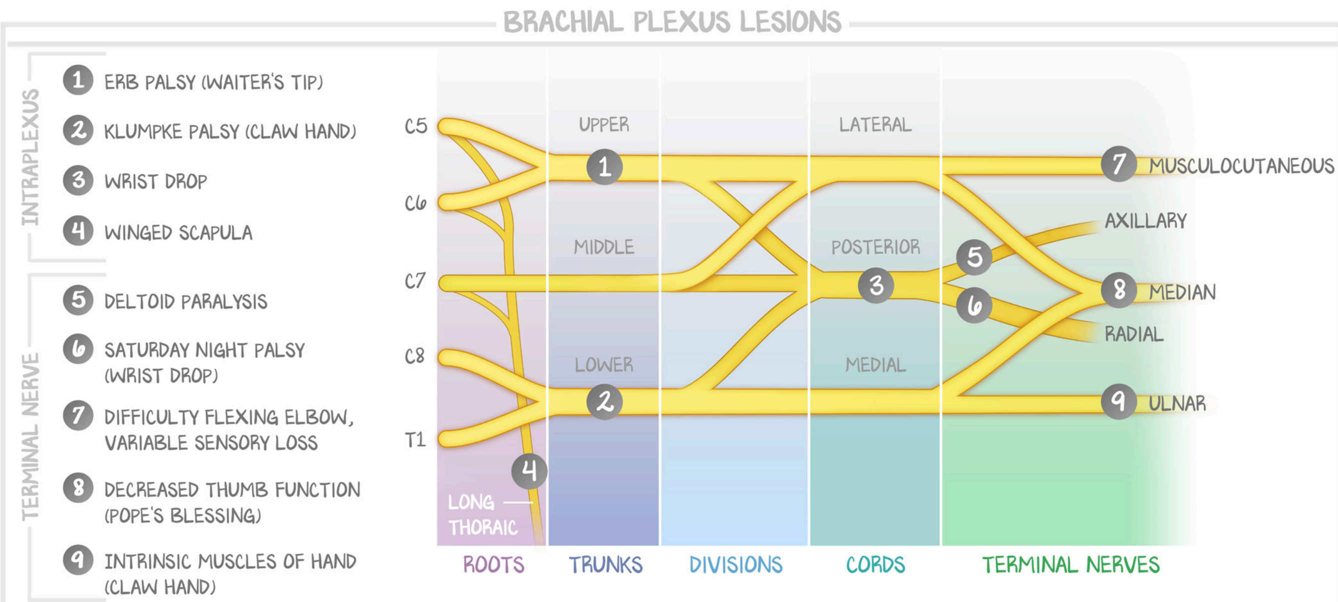



**Figure 3.5: Lesions Within and After the Brachial Plexus**
A schematic of the terminal and nonterminal nerve lesions affecting the cords or trunks.

## Brachial Plexus Lesions 2: Lesions within the Brachial Plexus

**Erb's palsy** is a lesion of the **upper trunk**, a combination of **C5** and **C6**. This happens in two classic scenarios, both of which cause a stretch, and thereby a shearing, of the upper roots, the upper trunk of the plexus. The first scenario is during birth, when there is **lateral traction on the neck** during delivery (head pulled left, right nerve trunk shears. The second is in adults who suffer a traumatic injury where the head is moved vigorously to one side, as in a car crash or landing on the face from a fall. What you lose is the posterior rotator cuff, deltoid, and biceps. This causes a **loss of abduction** (deltoid, axillary nerve; supraspinatus, supraspinatus nerve), **loss of external rotation** (infraspinatus, supraspinatus nerve), and **loss of flexion and supination** (musculocutaneous nerve) of the forearm. All of these make sense, as all of these nerves are high up on the shoulder, and high up on the nerve roots. This results in a "waiter's tip" deformity. The arm is hanging to the side, in contact with the torso (no abduction), the shoulder is internally rotated (no external rotation), the elbow is in extension (loss of flexion), and the hand pronated (loss of supination).

**Klumpke's palsy** is a lesion of the **lower trunk**, a combination of **C8** and **T1**. This happens in two classic scenarios, both causing a stretch and thereby shearing, of the lower roots, the lower trunk of the plexus. To do this, the arm must be abducted—exposing the lower trunk to stretch. The first scenario is during birth, if a baby's arm is pulled. The second is an adult who falls from a height then catches onto a railing or tree branch to abort the fall. The lower cord is injured. The ulnar nerve receives all its nerve tissue from the lower cord. The **ulnar nerve is lost**. The lower cord contributes to the hand portions of the radial and median nerves. The **radial nerve and median nerve in the hand are lost**. With this lesion, there is **total loss of all intrinsic** hand muscles—interossei, lumbricals, thenar, and hypothenar muscles. The extrinsic muscles are still intact-ish (the more proximal median nerve provides extrinsic flexors while the proximal radial nerve supplies extrinsic extensors). The result, and what you should learn, is there is a **lumbrical deficiency**. This results in the inability to flex MCP (so **now extended**) and the inability to extend DIP and PIP (so **now flexed**) in all 5 digits.

**Thoracic outlet syndrome** is a specialized variant of Klumpke's palsy, but is not caused by a tearing or shearing of the nerve, but rather by **external compression**. Caused by a Pancoast tumor (a big lung tumor) or a **cervical rib**, there is still a lesion of C8–T1. Because the neural lesion is the same, the same **claw hand** is found. But because thoracic outlet syndrome includes compression of not only the nerves, but also the vessels, there are also findings of vascular occlusion—**ischemia** (arterial), **edema**, and **thrombosis** (venous).

**Winged scapula** is a lesion of the **long thoracic nerve**. It is technically a terminal nerve, but not one of the arm. The long thoracic is formed from C5 to C7. The long thoracic nerve innervates the **serratus anterior**. The serratus anchors the scapula to the thoracic cage, rotating the scapula to get the arm above the horizontal plane. That is, the serratus anterior is responsible for **abduction** of **the shoulder past 100°** and the loss of that nerve (or muscle) means that abduction cannot go past 100°. The way this nerve gets lesioned is with **axillary node dissections after mastectomy** (iatrogenic, making it a priority thing to learn and be tested on) or from knife wounds.

| PALSY | LESION | FUNCTIONAL LOSS | SOUNDS LIKE |
|---|---|---|---|
| Erb's palsy<br>("waiter's tip") | Upper trunk lesion (C5–C6)<br>Tearing, lateral displacement of head | Abduction<br>External rotation<br>Elbow flexion<br>Forearm supination | Hanging at side<br>Internal rotation<br>Elbow extension<br>Hand pronated |
| Klumpke's palsy | Lower trunk lesion (C8–T1)<br>Tearing or traction, abducted and outstretched arm | Loss of all intrinsic hand muscles—the lumbricals predominate | Total claw hand, all digits are extended at MCP and flexed at DIP and PIP |
| Thoracic outlet syndrome | Lower trunk lesion (C8–T1)<br>Compression of the nerves as well as vasculature | Same as above<br>and<br>Cervical rib or Pancoast tumor | Same as above<br>and<br>Edema, ischemia, thrombosis |
| Winged scapula | Lesion of the long thoracic nerve (C5–C7)<br>Axillary lymph node dissection gets the nerve, not roots | Serratus anterior, abduction above 100°<br>Achieves this abduction by rotating scapula by pulling on thoracic cage | Inability to abduct shoulder above 100°<br>And scapula is not connected to thorax, "winging" |

**Table 3.4: Brachial Plexus Lesions Not of the Terminal Nerves**
Your mastery of the lesions, nerves, mechanisms, and clinical presentations must be such that you can identify or describe any one of them, given any one of the others.

## Brachial Plexus Lesions: Lesions of Terminal Nerves

The **axillary nerve** innervates the deltoid muscle and is irrigated by the deep humeral circumflex artery. In a fracture of the surgical head of the humerus, the arterial supply to the axillary nerve may be compromised. Direct axillary nerve impingement occurs during **anterior dislocation** of the shoulder. Losing the axillary nerve means weakness in the deltoid (**deltoid atrophy** and **loss of arm abduction > 15**°) as well as **sensory loss** of the lateral and distal deltoid (the supraclavicular nerve is preserved in axillary nerve injuries).

The musculocutaneous nerve is lesioned as part of a brachial plexus trunk lesion (Erb's palsy). It is responsible for the sensory loss of the forearm, loss of the supination of wrist, and loss of flexion at the elbow because it innervates the biceps. It is called out as its own lesion here for completeness. Learn it only as part of Erb's palsy.

**Radial nerve** lesions result in the dysfunction of motor **extension** as well as **dysfunction of sensation over the extensors**—everything on the posterior of the arm and hand is lost. Radial nerve (C5–T1) lesions are caused by compression at the axilla. Compression at the axilla is caused either by **overuse of crutches**, or more classically (though not more commonly) by a drunk falling asleep in a bar with his arm over the back of a chair, thus its epithet, "Saturday night palsy." It can also be caused by a midshaft humeral fracture. Radial nerve injuries cause **wrist drop**. The radial nerve innervates motor of the posterior compartment (muscles of wrist extension and extrinsic finger extension), and loss of the radial nerves causes **loss of wrist extension** as well as **loss of all digit extension**. Based on the level of radial nerve injury, since the radial nerve also innervates the muscles of elbow extension (the triceps), there could also be a loss of elbow extension.

**Median nerve** lesions are of three types: proximal, distal, or carpal tunnel.

A **proximal median nerve lesion** is caused by a **supracondylar fracture of the humerus** where the median nerve runs together with the brachial artery. Supracondylar fractures are common elbow fractures suffered by children who fall on an outstretched hand. With loss of the proximal median nerve, a lot of nervous connections are also lost. For **sensation**, there is loss of cutaneous sensation of the palmar aspect of the hand and fingers of **digits 1, 2, 3, and half of 4.** For **motor**, much is lost. The **extrinsic flexors** (forearm) of those digits are lost, so both the fingers and the wrist cannot flex. The **thenar muscles** are lost. The **intrinsic flexors** (hand) of digits 2 and 3 are lost. Finally, there is loss of the **lateral lumbricals**. When the patient tries to make a fist, the thumb won't adduct or flex, digits 2 and 3 won't flex, and only the fourth and fifth digits move, resulting in the "pope's blessing." All flexion is lost, so the lesion is seen when the wrist and fingers start extended and the patient tries to make a fist, from extension to flexion.

A **distal median nerve lesion** spares the anterior compartment of the forearm (sparing finger and extrinsic wrist flexors) and also spares the thenar sensation because of the palmar cutaneous sensory branch. This results in retention of the ability to flex the digits and wrist, which means the "pope's blessing" seen in proximal lesions is not seen. But because the **lumbricals** are still impaired, there will be an inability to flex digits 1, 2, and 3, resulting in a "median claw" when attempting to extend the digits. It is the combination of **functional extrinsic flexors** and the **lost lumbrical extension** that generates the median claw deformity. Functional extrinsic flexors means the patient can make a fist. The problem in a distal median nerve lesion is the failure of the lumbricals to extend.

Carpal tunnel syndrome is an impingement of the distal median nerve. It presents with paresthesia. Extreme cases of carpal tunnel present with thenar weakness and atrophy. Carpal tunnel will be evaluated and intervened on prior to developing the complete distal median nerve lesion just described. A distal median nerve lesion resulting in the median claw will not be from carpal tunnel, but from an acute and severe median nerve injury.

Memorize the median nerve lesions in great detail. Recognize their illustrations and what the patient looks like. The reason for this is that the ulnar nerve lesions' illustrations and patient presentation, when demonstrated in a still image, look exactly like the median nerve lesions. The key to making the diagnosis is the presence and location of sensory deficit (the ulnar nerve does the front and back of digits 4 and 5) and what action the patient is making to create the hand deformity. The "ulnar claw" is like the "pope's blessing," except that the patient is extending ("pope's blessing" is flexing) and there is sensory loss of the fourth and fifth digit. The "OK gesture" (ulnar lesion) is the "median claw" (median lesion) but with loss of sensory of the fourth and fifth digit and the patient is flexing (median claw is extending). If you memorize just the median nerve lesions, you won't end up confusing the ulnar lesions in your memory. Memorize the median nerve lesions; use deductive reasoning for ulnar nerve lesions.

**Ulnar nerve lesions** can also be distal (Guyon's canal, hamate fracture) or proximal (medial epicondyle fracture of humerus or **sustained compression of ulnar nerve during surgery**). The ulnar nerve runs through a groove of the humerus, very near the surface, so is easily compressed. This is why such great care is made to pad a patient's arms during surgery. The ulnar nerve is also your "funny bone."

In **proximal ulnar nerve** lesions, there is a loss of sensation of the fourth and fifth digits, loss of the medial lumbricals, and loss of the flexors of digits 4 and 5. When flexing into a fist from an extended hand, the fourth and fifth digits do not flex, and remain extended.

In **distal ulnar nerve** lesions, there is a loss of sensation of the fourth and fifth digits as well as loss of the medial lumbricals. The lumbricals extend the digits from a fist, and so the fourth and fifth digits will fail to extend during extension. Because the anterior compartment is spared, the extrinsic flexors of the digits and the flexors of the wrist are intact, so the lesion is pronounced.

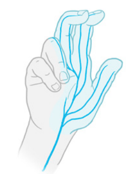
| NERVE | MECHANISM | FUNCTIONAL LOSS | RESULTS IN | LOOKS LIKE |
|---|---|---|---|---|
| Axillary nerve | Humerus fx—surgical neck<br>Anterior dislocation | Deltoid motor<br>Deltoid sensation | Loss of abduction 15°-100°<br>Loss of sensation | |
| Radial nerve | Humerus fx—midshaft<br>Compression, crutches, Saturday night palsy | Extensors<br>Triceps<br>Wrist extensors<br>Finger extensors<br>Sensory | Depends on level of injury<br>Loss of elbow ext.<br>Loss of wrist ext.<br>Loss of finger ext.<br>Loss of posterior sensation | |
| Median nerve, proximal<br>(“pope’s blessing”) | Humerus fx—supracondylar | Wrist flexors<br>Finger flexors<br>Lateral lumbricals<br>Lateral palmar sensory | Cannot flex wrist<br>Cannot flex fingers of 1, 2, and 3<br>If passively flexed, cannot extend digits 1, 2, and 3<br>Loss of sensation, including thenar eminence | <br>When flexing from extension |
| Median nerve, distal<br>(“median claw”) | Carpal tunnel | Lateral lumbricals lost<br>Anterior compartment spared (extrinsic flexors)<br>Thenar innervation spared | Cannot extend digits 1, 2, and 3<br>Can flex them<br>Retained thenar sensation | <br>When extending from a fist |
| Ulnar nerve, proximal | Humerus fx—medial epicondyle<br>Surgical table | Medial lumbricals<br>Finger flexors<br>Sensation | Cannot extend digits 4, 5<br>Cannot flex digits 4, 5<br>Loss of digit sensation 4 and 5 | <br>When flexing from extension |
| Ulnar nerve, distal | Guyon’s canal<br>Hamate fracture | Medial lumbricals<br>Extrinsic flexors spared<br>Ulnar sensation | Cannot extend digits 4, 5<br>Can flex them<br>Loss of digit sensation 4 and 5 | <br>When extending from a fist |

**Table 3.5: Brachial Plexus Lesions of the Terminal Nerves**
The different lesions that arise from terminal nerve injuries vary based on where they are injured—proximal or distal—distal sparing more function than proximal. Separating the lesions based on the presence or absence of forearm activity assists in diagnosing the level of the lesion, as does memorizing the hand changes.